

**A second species of the rare milliped family Apterouridae
(Diplopoda: Chordeumatida: Striarioidea)**

William A. Shear

Biology Department, Hampden-Sydney College, Hampden-Sydney, Virginia 23943, U.S.A.

Abstract.—*Apterourus serratus*, sp. nov., is described from a single male collected in Monterey County, California, U.S.A. This is the fourth sexually mature specimen and second species in the family to be found since the original collection of *A. horizontalis* Loomis, in 1929. Features of the gonopods of the new species and second and ninth legs confirm the placement of the family in the suborder Striarioidea, superfamily Striarioidea. New figures of the gonopods of *A. horizontalis* are provided.

A number of families of millipeds are not only monobasic (including a single genus) but are also based on monotypic genera (including a single species). For many of these families, their apparent distinctness is the result of our ignorance, i.e., we have not understood the real relationships of the species involved or have yet to find their relatives. In such cases, the system may be best served by eventually collapsing the monobasic families into larger units that more accurately reflect their phylogenetic position. For a few of them, however, their monobasic states may be the taxonomic consequence of the great age of the group, as the last remnants of phyletic lines isolated by extinction. In such cases, the maintenance of these taxa seems well justified, although such status can only be inferred by their evident distinctness from their nearest relatives. Such appears to be the case for the milliped family Apterouridae.

The family Apterouridae was established by Loomis in 1966 for the single species *Apterourus horizontalis*, described as new from specimens that had been collected in southern California by O. F. Cook in 1929. When I surveyed North American chordeumatids in 1972, the type specimens of *A. horizontalis* Loomis (the only known material) were unavailable for study, and the

original description lacked information needed for an accurate systematic placement of the family. The specimens were finally located in the collections of the National Museum of Natural History (Smithsonian Institution), and in 1977 I re-described *A. horizontalis*, correcting a number of crucial errors due to the failure of Loomis to completely dissect the male; these errors were the source of the taxonomic problems. Properly understood, apterourids find a place as members of the superfamily Striarioidea, a moderately diverse assemblage of chordeumatidans limited, except for one species, to North America, and with its center of diversity along the Pacific Coast.

Order Chordeumatida Koch, 1847

Suborder Striarioidea Cook, 1896

Superfamily Striarioidea Cook, 1896

Family Apterouridae Loomis, 1966

Apterouridae Loomis 1966:221.—Shear, 1972:247; 1977:689.

Diagnosis.—Thirty segments in both sexes. Terga granulate, strongly arched, bearing prominent bilobed paranota. Gonopods with two colpocoxites, one of which sheaths a branch or branches of a flagellocoxite. Ninth legs strongly reduced, lacking telopodites, concealed beneath reflexed gonopods, wholly enclosed within seventh

diplosegment. Coxae 10 and 11 with ever-sible glands. Openings of vas deferentia on posterior surfaces of second coxae, surrounded by short, membranous tubes. Monobasic.

Notes.—My earlier discussion of the family (Shear 1977) corrects the erroneous interpretations in the original description (Loomis 1966). However, in 1977 my understanding of chordeumatid gonopods and the relationships of the families was quite different than it is now (Shear 2000). Additional study of the gonopods of several striariidean families has led to a more accurate interpretation.

Chordeumatidan gonopods are primitively derived only from the modified eighth legpair. The ninth legpair should be called “posterior gonopods” only in members of the suborders Chordeumatidea and Heterochordeumatidea, where their modification suggests a possible role in spermatophore transfer. Indeed, in a few species of these groups, the anterior gonopods are completely suppressed and their function has been entirely assumed by the posterior gonopods, a development that has led to considerable confusion. In the suborder Striariidea, the ninth legs have coxites only in the superfamily Caseyoidea, and there they only serve to physically support the gonopods. In the superfamily Striarioidea, to which the Apterouridae undoubtedly belong, ninth leg coxites are absent. The ninth legs are very strongly reduced in both known species of apterourids, and completely concealed *in situ* by the gonopods; there is no evident division between sternum, coxa and telopodite.

Returning to the gonopods proper, I am now sure that all choreumatidan gonopods are derived entirely from the coxae, and the telopodite of the eighth leg plays no role. Vestigial telopodites are present in a few families of the superfamilies Brannerioidea and Antroleucosomatoidea (see, for example, Shear 2002), where they appear as small, articulated, rodlike structures bearing a few apical setae. What I persistently

called “telopodites” prior to about 1995 are, in fact, colpocoxites, the sclerotized and sometimes elaborated homologs of the coxal glands of the eighth legpair. The rest of the elaborations of the gonopod are properly referred to as angiocoxites: derived from the body of the coxa and rim of the coxal gland opening.

The following general description of apterourid gonopods incorporates these new interpretations. There appears to be no distinct sternum, and the sternal apodeme arises directly from the coxal region (Fig. 3A), which therefore is best termed a coxosternite. The right and left gonopods are separate and linked only by lightly sclerotized membrane. As in other Striariidea, each angiocoxite is fundamentally bipartite. The mesal section in *Apterourus* consists of two flagelliform branches, the inner being the largest (mc1, mc2, Fig. 1E). The outer, or ectal, angiocoxite section (ec, Fig. 1D) forms a broad sheath, within which is nested a movable flagellocoxite (fc, Fig. 1E; term introduced by Gardner & Shelley [1989]). Although I referred to a low, mound-like colpocoxite in *A. horizontalis*, I could not detect one in the new species, nor could such a structure be found on re-examination of the types of *A. horizontalis*. Either the colpocoxite is completely lacking, or what I am referring to as the flagellocoxite is in fact a colpocoxite. Unfortunately, it is not possible at this point to decide between these two alternatives.

I remain confident in my placement of the family in the Striariidea, and now it seems clear that the apterourids are the adelphotaxon of Striariidae + Rhiscosomidae, based on the flagelliform mesal angiocoxite branches and the extreme reduction of the ninth legs. The gonopods are apomorphic in comparison to those of the other two families in lacking a distinct sternum. Striariids and rhiscosomidids share a more plesiomorphic form of the ninth legs, with separate telopodites not concealed by the gonopods, and the mesal angiocoxites are robust, flattened, and bear

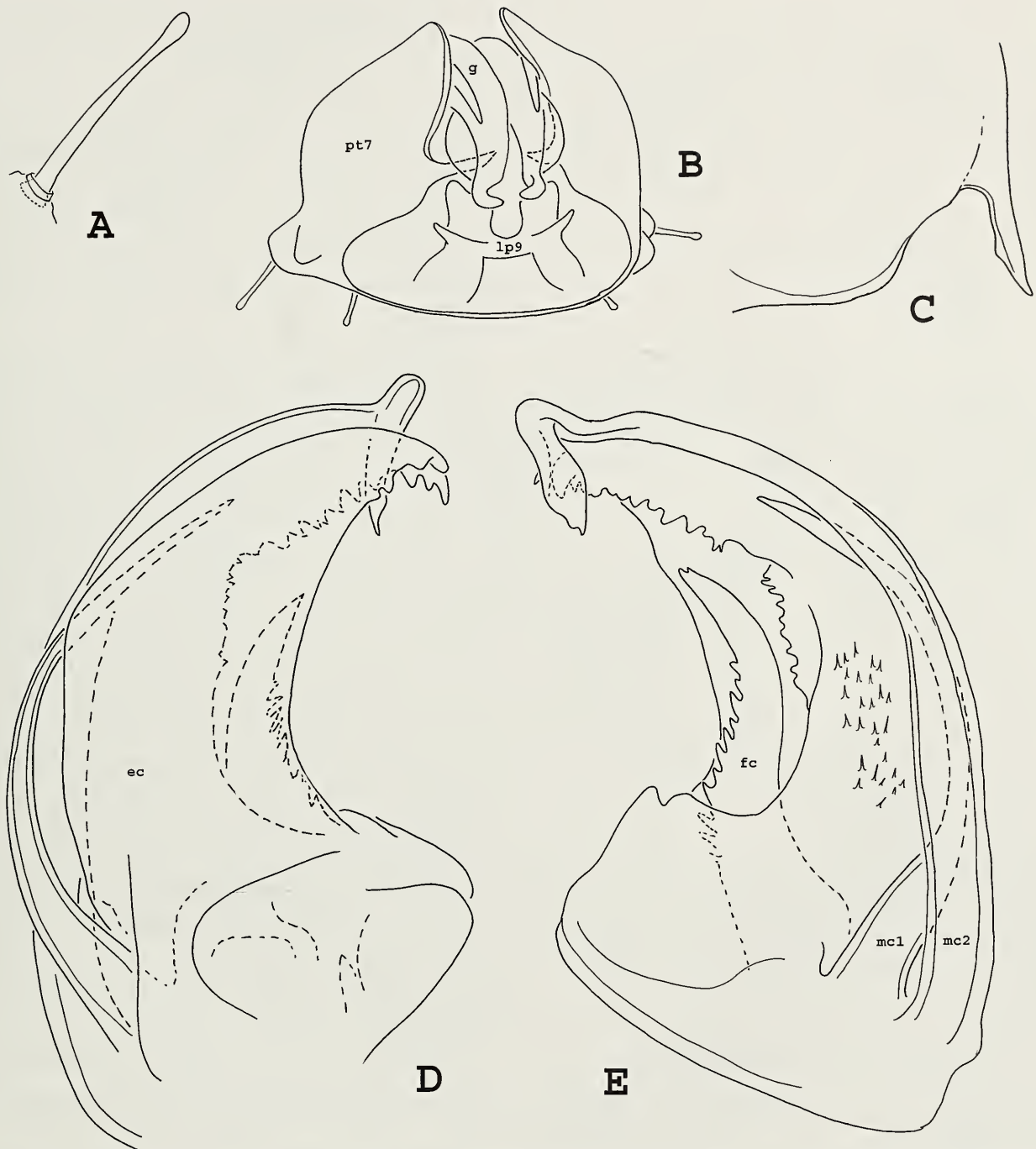


Fig. 1. *Apterourus serratus*, male. A. Typical segmental seta, 400 \times . B. Diagrammatic plan of segment 7, posteroventral view; pt7, paratergum 7; g, gonopod; lp9, legpair 9. C. Ventral margin of left pleurotergite, ventral view, 200 \times . D. Right gonopod, lateral view, 400 \times ; ec, ectal coxite. E. Right gonopod, mesal view, 400 \times ; fc, flagellocoxite; mc1, mc2, branches of mesal coxite.

apical elaborations. All three families are characterized by rather heavy sclerotization and the presence of paranota, though it is not clear that the paranota are homologous in all of them. Those of the rhiscosomidids and apterourids look similar, but paranota-like extensions in an undescribed genus of striariid (minute creatures recently recognized in collections from Califor-

nia and Oregon) appear to be exaggerated segmental crests set low on each segment. The smaller basal lobe of an apterourid paranotum is actually a distinct structure, set higher on the segment than the main part of the paranotum, raising the possibility that the two are developed from separate crests, the remainder of which have been entirely suppressed.

***Apterourus serratus*, new species**

Figs. 1, 2

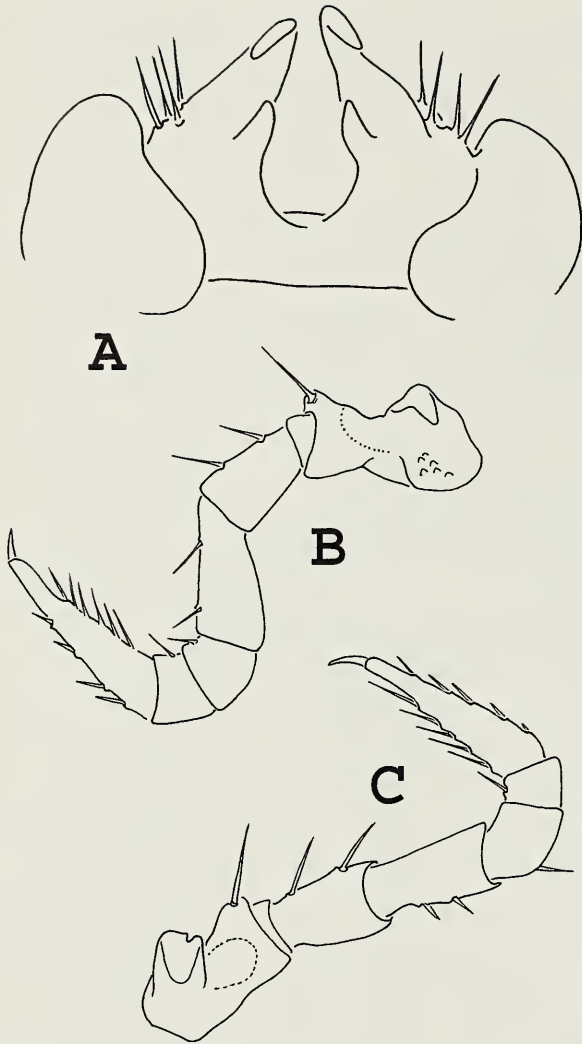


Fig. 2. *Apterourus serratus*, male. A. Ninth legs, anterior view, 200 \times . B. Right tenth leg, anterior view, 200 \times . C. Left eleventh leg, anterior view, 200 \times .

Apterourus Loomis, 1966

Apterourus Loomis 1966:221.—Shear, 1977:689.

Diagnosis.—As for family.

Contents and distribution.—*Apterourus horizontalis* Loomis, *A. serratus*, sp. nov. Known from two localities in southern California. The localities are separated by about 435 km, a rather remarkable distance. I strongly suspect that additional species of *Apterourus* await collection and description in the intervening region.

Notes.—The name of the genus is a Greek neologism roughly meaning “wingless tail,” and refers to the absence of paranota posterior to segment 26 in *A. horizontalis* (Loomis 1966).

Type.—Male holotype (Essig Entomological Museum, University of California, Berkeley) from California, Monterey County, 12 km SE of California Highway 1 on Palo Colorado Road, collected in a pitfall trap by A. Gilbert and B. Oliver, 23 Feb 1984.

Diagnosis.—Distinct from *A. horizontalis* in details of the gonopods, ninth legpair, and tenth coxae; the inner edge of the flagellocoxite of the gonopod of the present species is serrated, that of *A. horizontalis* smooth; the ninth leg coxae of *A. serratus* are much more reduced than in *A. horizontalis*, appearing as small hooks each with a single basal tooth, rather than as concave lamellae; the tenth coxae of *A. horizontalis* have a large apical knob that is absent in those of *A. serratus*. The modifications of the seventh segment of the male described below are not seen in *A. horizontalis*. Additionally, the males of *A. horizontalis* have 4–5 poorly developed, indistinct ocelli, while the single male of *A. serratus* has 15 uniform, well-defined ocelli in an oval group. The posterior lobes of the paranota are acute in *A. horizontalis*, rounded in *A. serratus*.

Etymology.—The species epithet refers to the serrate margins of the gonopod coxites.

Male holotype.—Length, about 5.8 mm; width, 0.8 mm across the paranota of segment 6. Structure generally as described for *A. horizontalis* (Loomis 1966, Shear 1977), but paranota smaller, thicker, with posterior lobe low and rounded; paranota growing smaller after segment 18, absent from segments posterior to 24. Metazonites coarsely granular, especially at bases of paranota. Segmental setae (Fig. 1A) blunt-tipped. Color dark brown. Pregonopodal legs (pairs 3–7) slightly more crassate than postgonopodal legs; legpair 3 not notably larger than others, lacking modifications to prefemora.

Segment 7 modified (Fig. 1B, C); pleu-

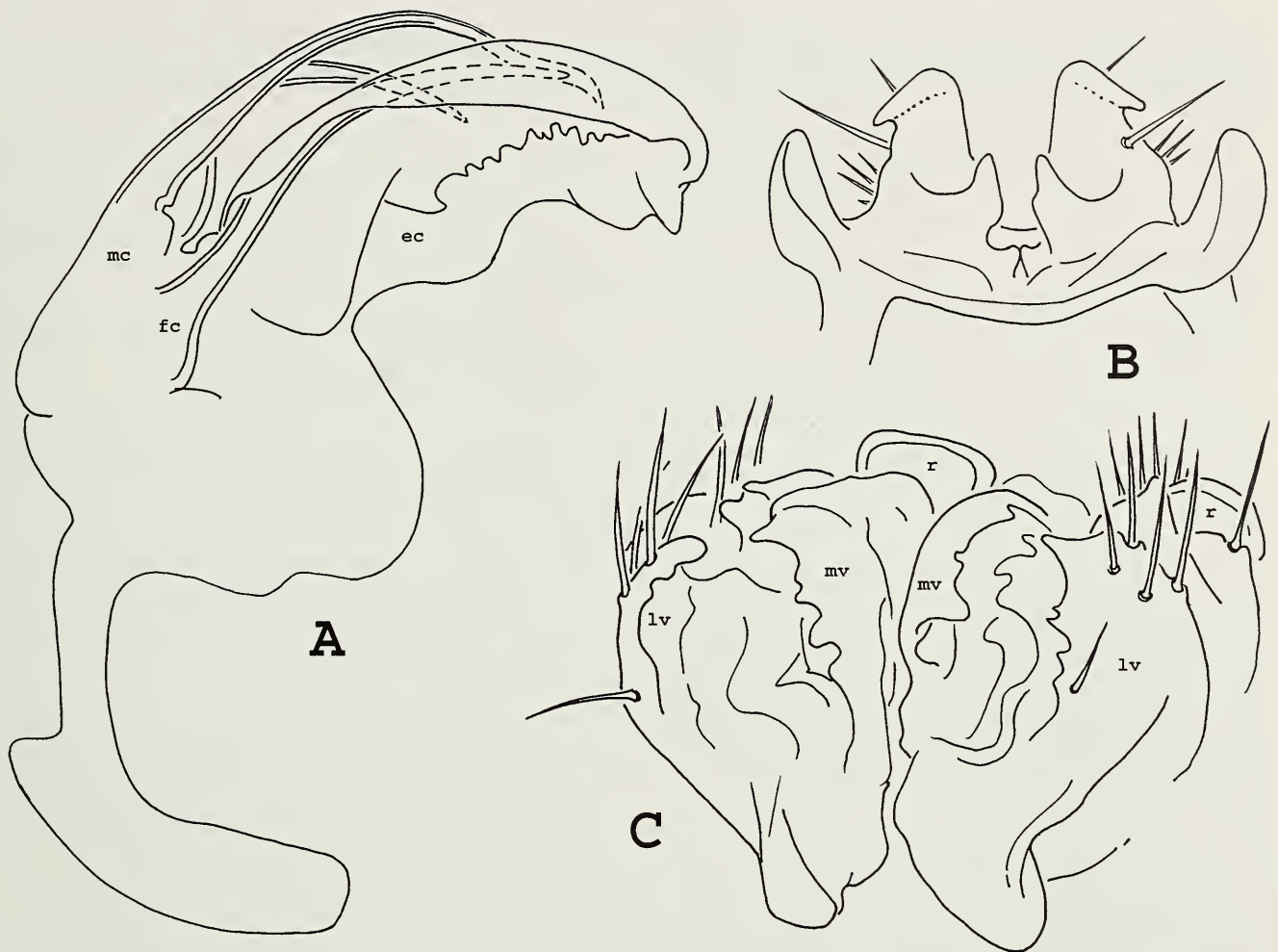


Fig. 3. *Apterourus horizontalis*. A. Left gonopod, mesal view, 200 \times ; mc, mesal coxite; fc, flagellocoxite; ec, ectal coxite. B. Ninth legs of male, anterior view, 200 \times . C. Female genitalia, ventral view, 200 \times ; lv, lateral valve; mv, mesal valve; r, receptacle.

rotergites meet in ventral midline, each bears long posterior extension fitting dorsal to gonopods.

Gonopods (Fig. 1D, E) with ectal coxite (ec) broadly based, apically acuminate, outer margin with few distal teeth, inner margin conspicuously serrate. Mesal coxite (mc1, mc2) bipartite; outer branch short, curved, acute; inner branch longer, heavier, sharply curved mesoventrally at tip. Flagellocoxite (fc) broad, with distinct, even, marginal serrations. Ninth legs (Fig. 2A) consisting of single, fused coxosternal unit, tapered, curved, with mesal teeth on each side, with lateral setal group. Legpairs 10 (Fig. 2B) and 11 (Fig. 2C) with coxal glands, coxae 10 without distal knobs.

Female unknown.

Distribution.—Known only from the type locality.

Notes.—The pitfall trap from which the type was taken was evidently in place all winter, having been set up in November and collected in February. No information is available on the nature of the habitat. *Apterourus horizontalis* was also collected in February, and this meager evidence points to surface activity by these millipeds in the cooler, rainier winter months.

Apterourus horizontalis Loomis, 1966

Fig. 3

Apterourus horizontalis Loomis, 1966:223, figs. 1–4.—Shear, 1977:689, figs. 1–8.

Types.—Male holotype, male, female and juvenile paratypes from Cajon Pass, 11.25 km W of Cajon on Big Pine Road, San Bernardino Co., California, collected 14 Feb 1929 by O. F. Cook, deposited in

the National Museum of Natural History, Smithsonian Institution (myriapod collection, USNM 3159).

Notes.—I re-examined the types for this study. My earlier redescription is generally accurate, but in my 1977 fig. 1, the segmental setae are shown as acute; in fact they are blunt and slightly clavate as in *A. serratus* (Fig. 1A, this study).

For purposes of comparison with the new species, new figures of the gonopods (Fig. 3A) and ninth legs (Fig. 3B) are presented here. While I characterized the gonopod in 1977 as having a low, mound-like colpocoxite (“telopodite”), I cannot now, using better optical equipment, detect such a structure. Because of a growing awareness that the female genitalia of millipeds may be of taxonomic utility, those of *A. horizontalis* are illustrated here (Fig. 3C).

Acknowledgments

Thanks are due to C. Barr, curator of the Essig Entomological Museum, for the loan of material which contained the holotype specimen of *A. serratus*, and to J. Coddington, Smithsonian Institution, for the loan of the types of *A. horizontalis*.

Literature Cited

- Cook, O. F. 1896. On recent diplopod names.—*Brandtia* 2:5–8.
- Gardner, M., & R. Shelley. 1989. New records, species and genera of caseyid millipeds from the Pacific coast of North America (Diplopoda: Chordeumatida: Caseyidae).—*Pan Pacific Entomologist* 65:177–268.
- Koch, C. L. 1847. System der Myriapoden. Pp. 61–119 in A. Herrich-Schäffer, ed., *Kritische Revision der Insectenfauna Deutschlands*, vol. 3.
- Loomis, H. F. 1966. Two new families and other North American Diplopoda of the Suborder Chordeumida.—*Proceedings of the Biological Society of Washington* 79:221–230.
- Shear, W. A. 1972. Studies in the milliped order Chordeumida (Diplopoda): a revision of the family Cleidogonidae and a reclassification of the order Chordeumida in the New World.—*Bulletin of the Museum of Comparative Zoology* 141:151–352.
- . 1977. The systematic position of the milliped family Apterouridae (Diplopoda, Chordeumida, Striarioidea) and a redescription of *Apterourus horizontalis* Loomis.—*Proceedings of the Biological Society of Washington* 89:689–694.
- . 2000. On the milliped family Heterochordeumatidae, with comments on the higher classification of the order Chordeumatida (Diplopoda).—*Invertebrate Taxonomy* 14:363–376.
- . 2002. Five new chordeumatid millipeds from China: New species of *Vieteuma* (Kashmireumatidae) and *Nepalella* (Megalotyliidae).—*Proceedings of the California Academy of Science* 53:63–72.